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Original Article

Laboratory evaluation of fracture strength in fragment reattachment of fractured central incisor using Dual cure resin Cement and flowable Composite

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ABSTRACT

Statement of the Problem: fracture of anterior teeth are unpleasant experiences for children and they necessitate to be treated as soon as possible This study aimed at comparing fracture strength of sound teeth with teeth reattached with two different materials. Materials and Method: 24 sound central incisor teeth fractured by an axial load imposed on buccal area were divided in two groups. Third group included 12 sound teeth. Teeth were restored as: reattached with dual cure cement, reattached with flowable composite and sound teeth considered as control. Teeth were fractured due to pushing pressure on lingual area. Required force for fracture of each sample was recorded. Average force rate for first, second and third groups were 548.17 N, 498.75 N, and 858.25 N, respectively. Results: Results suggest a significant difference between average rate of first group with control group and that of the second group with control, but average rate of group 1 and group 2 had no significant difference. Conclusion: Material combination used to reattach the fragments did not play an important role in the fracture strength.

Keywords: Fragment reattachment, fracture strength, Dual cure Cement, flowable composite.

Introduction

The anterior crown may fracture in 25% of people, this mostly limits to a single tooth and usually to maxillary central incisor especially in mesial and distal edges. The fractures may happen horizontally in parallel with mesiodistal. Sometimes just the middle part of incisal edge is involved. Rarely can the fracture cover the entire facial surface [1]. The most prevalent etiologic factor of crown fracture in permanent teeth is damages due to the falls, clash sports, accidents, and collision of external objects with teeth [2].

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There are various kinds of treatments for these damaged teeth including composite restorations, crown reconstruction, prosthetic treatment and dental fragment reattachment which, in many clinical cases, dental fragment reattachment is the best one for fractured anterior teeth. Because this is a proper method for retaining the form, cantor, superficial view, occlusal order and the fragment dye. Besides, dental fragment reattachment returns the beauty and function and it is economical, reduces the prosthesis treatment for the young patients and brings in positive social and emotional responses for patients [3, 4]. Also occlusal guide is maintained and creates a cover like healthy adjacent teeth, conversely when composite or Porcelain is used. Dental fragment reattachment is possible both with sticky technique and restorative materials. Studies and long term follow-ups in which reattachment is done by sticky ivory material or sticky systems, had accomplishments for more than seven years in terms of beauty and function [4]. In the past, mostly the topics of discussion were about the preparation methods and scratch mode, but today combination of various materials for reattachment of dental segments is compared. Andreasen concluded that there is a good relationship between the material and mechanical properties of

restoration in dental segment reattachment, for instance, it is better to use only composite instead of using sticky factor. Sometimes, the fracture involves a wide area of ivory that can be troublesome for polymerization with light cure unit. So, using a self-hardening material or dual cure is essential [5].

Badami found that resistance against dental fracture with reattached dental segment is not like the resistance of sound and healthy teeth. He used two different sticky materials such as Gluma2000 and Schotch bond2 for dental reattachment and concluded that the required force for fracture with dental segments reattached by Gluma2000 was considerably ($P < 0.1$) more than that for dental segments reattached by Schotch bond 2 [6].

Dean investigated the fracture force on teeth with dental segments reattached by composite hardening with light, Glass - ionomer hardening with light. They concluded that there was not any significant difference between the forces of fractures [7].

Pagliarini et al, evaluated the required force for separation of dental segments reattached by fourth and fifth generation of Dentin – enamel sticky materials and found that, for separation of dental segment reattached by fourth generation of Dentin – enamel sticky materials, more force is required [8].

Reis compared the fracture force while using different preparation techniques for reattachment of dental segments and concluded that there was more fracture force (67.9%) in groups with chamfer than groups with no chamfer (41.11%) and both of them had statistically less force than that of crown reconstruction by composite [1].

In this study, the fracture strength of reattachment of central incisor was investigated after using two different materials. The aim of this study was to find the best material for reattachment of fractured central incisor.

Materials and Method

The present study was done experimentally in laboratory. The number of samples was determined to be 12 for each group based on the previous studies and in accordance with the view of statist. Thirty-six sound maxillary central incisors, without decay and crack pulled at most six months ago were selected in this study. Any kind of dental calculus, debris and soft tissue around the root was separated by Kontron pen and teeth got clean with Prophylaxis Paste by brush and headpieces slowly and maintained until working in normal saline in room temperature, then all teeth were kept in self-hardening acrylic and in this stage the samples were divided into three groups of twelve, randomly.

In two groups (n=24), every single tooth was kept fixed in Universal testing machine and the force was imposed on Buccal surfaces on detected area by blade machine as fast as 1mm/min for bringing into fracture. Then, from the inside of the fractured segment, without any damage to the fracture margin, in order to insert the composite, it was lifted up by No. 1 dental drill. In enamel edge of fractured segment and the fractured segment, bevel was done for 1 mm. Then, the following steps were taken in each group:

Group 1: the internal surface and the beveled area of fractured segment and the fractured part of tooth was etched using phosphoric acid 37% for 25 seconds. Then, it wetted by water for 15 seconds and dried by air for 20 seconds. In this stage, the ivory was kept moisture to increase the strength of band. In next stage, one sticky layer to ivory (Excite, vivadent, likhtenstein) was separated on the prepared surface of segment and the tooth was brushed, and then dried by air for 20 seconds. Then, the drying process was done by gentle air and continued until the liquid flow disappears from the surface. Then, the banding layer hardened by light cure for 20 seconds. The flowable composite was inserted inside of the separated segment and kept fixed, the extra composite has been lifted up and after being hardened for 20 seconds, the ordinary restorations started.

Seconds group: all of the processes in group one were done except for that Dual cure Resin Cement (Variolink II, vivadent, liktenstein) which was used for pasting.

Third group: this group was considered as a control group and included sound teeth.

Then, the samples were kept in thermocycler machine between 5-55° C for 500 times; each time for 1 minute. In each stage, every sample was fixed in 45 °C and pressed on lingual tooth by Instron machine with 1mm/min to bring about the fracture. The required force for each fracture was recorded. Then, the results were analyzed by mean and SD.

Also, the mean of results were compared using ANOVA and Tukey.

Results

After statistical analysis, the following results about the fracture strength of the cases received. The mean of fracture strength in accordance with the rankings of this study in each group was as follows:

In group 1, 2, and 3, it equals to 548.17 N, 498.75 N and 858.28 N, respectively which according to the results, there was not a significant difference in fracture strength of group 1 and 2. The mean of fracture strength in group 3 was significantly more than the others (Table 1).

Table 1. Mean of fracture strength in each group

Group	No	Mean
1	12	548.17
2	12	498.75
3	12	858.25
Total	36	635.06

The mean of fracture strength in group 2 was less than the others, but did not have significant difference to group a, however, it had a significant difference to group 3 (P=0.029).

Discussion

Reattachment of dental segment in most clinical cases can be the best treatment for maxillary central incisor in which the dental

segment exists. Because the technique is fast and simple and only needs a composite layer and also returns the function to the patients, the anterior occlusion happens due to the contact of anterior teeth.

The quick treatment of these kinds of teeth is essential for maintaining the pulp tissue (in patients with no pulp involvement) and Periapical tissue [8].

According to the studies, in reattached teeth, about 98% of pulp tissue, when fractured, was seen to be living only in crown without pulp involvement [4]. In case that the segment does not exist, reconstruction of the crown with composite can be used. But the beauty will be short term and besides, the appropriate contour and also proximal contact will be difficult and more time is needed [1]. These composite restorations have less ideal results in terms of shape, color and incisal translucency. Prosthesis treatments in young patients are controversial due to the large size of pulp and fast growing. So, teeth growing and pulp must be considered [3].

Today, various materials for reattachment of dental segments are used for teeth and comparison of these materials with their band strength can help to identify the amount of dental attachment and its strength.

This study aimed to introduce the best and the most appropriate material for reattachment of the separated segment to the fractured tooth. In this study, three groups of teeth were selected which in each group, one type of material for reattachment of dental segment was used.

Group 1: the separated dental segment attached to the tooth by Dual Cure Resin Cement (VariolinkI I, vivadent likhtenstein).

Group 2: separated dental segment attached to the fractured tooth by flowable composite (Tetric flow, vivadent khtenstein).

Group 3: it was control group and included sound teeth.

According to the results, the mean of fracture strength of third group was significantly more than that of two other groups. In third group, the band strength of sound teeth was calculated and the result seems logical. Also, there was not a significant difference between the mean of band strength of first and second group and this result was consistent with that of Reis et al studies in 2002 [1]. Andreasen concluded that there is a good relationship between the material and mechanical properties of restoration in dental segment reattachment, for instance, it is better to use only composite instead of using sticky factor. Sometimes, the fracture involves a wide area of ivory that is can be troublesome for polymerization with light cure unit. So, using a self-hardening material or dual cure is essential [5]. Also, Dickerson in and Reis have used Dual cure resin cement and they reported the resistance against high fracture while using this material [1, 9] which is consistent with the results of our study.

In other studies, the same results have been received. Oliveria used one self-hardening composite and composite hardened with light and Glassionomer for reattachment of dental segment. He had not done any preparation in half of the samples and in other half, he created bevel in fracture line which resulted in more fracture strength in the group on which the bevel was done and did not find any significant difference while using different materials.

Dean did not find any considerable difference between dental fracture strength in which the fractured segment was reattached only by a sticky system and when the sticky system was used with composite hardening with light and base Glassionomer [7].

Today, in order to achieve better clinical results, while using composite hardening with light, it is recommended to use high luminous intensity and more light time and combination of these two factors can prevent from Polymerization of composites hardening with light.

When chemical resin materials and dual cure are used, the change of color in long term must be considered, because this issue effects on the beauty. Amine accelerator which is required for dual Polymerization can change color in a long term [10]. So, the resin cement hardening by light, cause more beauty in long time and dual cure resin cement is recommended when there is no extra preparation in fracture line of Buccal area [11].

According to the results of this study, a little dual cure resin cement has higher fracture strength and it can be justified and due to the dual cure Polymerization stage in this cement, the temperature of composite conversion is high and thus it suggests better physical properties. On the other hand, resin hardening results in longer pre gel stage in composite Polymerization and during this stage, the material becomes elastic and absorbs and distributes stresses. The longer the period of pre gel is, the less stress and the more band strength will be which this dual cure composite stage is longer due to the dual hardening. Thus, contraction of material will be minimized and band strength will be increased [12].

Another important problem is found in contraction during C Factor Polymerization which its amount equals to the ratio of banded surface to un-banded surface. The less the amount of C factor is, the less the contraction during Polymerization will be. Due to the creation of bubble while mixing dual cure cement, the un-banded surface increases and finally, the amount of C factor decreases which is another advantage of using dual cure materials.

But flowable composite needs penetration of light for Polymerization and because of decreasing the light intensity due to passing through the tooth tissue, Polymerization of material is insufficient, thus the physical and mechanical properties decreases [12].

In any case, regarding the above mentioned findings, the type of restorative material may not effect on the fracture strength of reattachment of dental segment, but the mean of fracture strength in the first and second group suggests that these digits are far more than the range of forces on anterior teeth equaling to 89-111 N. If in patients with Bruxism, this number increases to 300 N [13]. So, reattachment of dental segments can be a proper and conservative approach in Incisor teeth.

Reis [1] and Loguercio [14] separated the dental segment by Instron machine. In this study, segments were separated by Instron machine which this kind of fracture is slightly different from separation of segments by disc, so that in fracture method, the

segment is separated to the direction of enamel rods, but when diamond disc is used, one layer of tooth tissue is removed and the segment does not match with fractured tooth and this issue effects on the strength [1]. According to the latest studies, the fracture strength, when using the machine for separation of segment, is more than the time of using diamond disc [11].

In accordance with present study, the material type may not effect on the fracture strength, so the methods of dental segment reattachment should be investigated.

Using various materials in reattachment does not result in increasing band strength and it seems that different techniques of preparation of separated segment and tooth are effective.

References

1. Reis A, Kraul A, Francci C, de Assis TG, Crivelli DD, Oda M, et al. Re-attachment of anterior fractured teeth: fracture strength using different materials. Oper Dent. 2002; 27:621-7. www.ncbi.nlm.nih.gov/pubmed/12413229
2. Andreasen JO. Etiology and pathogenesis of traumatic dental injuries. A clinical study of 1,298 cases. Scand J Dent Res. 1970; 78:329-42. www.ncbi.nlm.nih.gov/pubmed/4394635
3. Murchison DF, Burke FJ, Worthington RB. Incisal edge reattachment: indications for use and clinical technique. Br Dent J. 1999; 186:614-9. www.ncbi.nlm.nih.gov/pubmed/10425806
4. Maia EA, Baratieri LN, de Andrada MA, Monteiro S, Jr., de Araujo EM, Jr. Tooth fragment reattachment: fundamentals of the technique and two case reports. Quintessence Int. 2003; 34:99-107. www.ncbi.nlm.nih.gov/pubmed/12666858
5. Andreasen FM, Steinhardt U, Bille M, Munksgaard EC. Bonding of enamel-dentin crown fragments after crown fracture. An experimental study using bonding agents. Endod Dent Traumatol. 1993; 9:111-4. www.ncbi.nlm.nih.gov/pubmed/8243342
6. Badami AA, Dunne SM, Scheer B. An in vitro investigation into the shear bond strengths of two dentine-bonding agents used in the reattachment of incisal edge fragments. Endod Dent Traumatol. 1995; 11:129-35. www.ncbi.nlm.nih.gov/pubmed/7641629
7. Dean JA, Minutillo AL, Moore BK. A comparison of a hybrid light-cured glass-ionomer base and liner vs. a light-cured resin tooth fragment attachment. Pediatr Dent. 1998; 20:49-52. www.ncbi.nlm.nih.gov/pubmed/9524973
8. Palma-Dibb RG, Taba M, Jr., Santos CM, Navarro VP. Autogenous tooth fragment reattachment--association of periodontal surgery and endodontic and restorative procedures: a case report. Quintessence Int. 2004; 35:179-84. www.ncbi.nlm.nih.gov/pubmed/15119674
9. Dickerson WG. Conservative reattachment of a pulpally exposed, fractured incisor. Dent Econ. 1994; 84:90-1. www.ncbi.nlm.nih.gov/pubmed/8062998
10. Rosenstiel SF, Land MF, Crispin BJ. Dental luting agents: A review of the current literature. J Prosthet Dent. 1998; 80:280-301. www.ncbi.nlm.nih.gov/pubmed/9760360
11. Reis A, Loguercio AD, Kraul A, Matson E. Reattachment of fractured teeth: a review of literature regarding techniques and materials. Oper Dent. 2004; 29:226-33. www.ncbi.nlm.nih.gov/pubmed/15088736
12. Sumitt J, Robvins W, Hilton T, Schwartz R. Fundamental of Operative Dentistry. 3rd ed: Mosby inc; 2006; 295-302.
13. Loose M, Rosentritt M, Leibrock A, Behr M, Handel G. In vitro study of fracture strength and marginal adaptation of fibre-reinforced-composite versus all ceramic fixed partial dentures. The European journal of prosthodontics and restorative dentistry. 1998; 6:55-62.
14. Loguercio A, Mengarda J, Amaral R, Kraul A, Reis A. Effect of fractured or sectioned fragments on the fracture strength of different reattachment techniques. Operative Dentistry-University of Washington-. 2004;29:295-300.